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REPORTING GUIDELINES FOR META-ANALYSIS IN ECONOMICS

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Abstract. Meta-analysis has become the conventional approach to synthesizing the results of empirical economics research. To further improve the transparency and replicability of the reported results and to raise the quality of meta-analyses, the Meta-Analysis of Economics Research Network has updated the reporting guidelines that were published by this Journal in 2013. Future meta-analyses in economics will be expected to follow these updated guidelines or give valid reasons why a meta-analysis should deviate from them.

Keywords. meta-analysis; meta-regression; reporting standards

1. Introduction

Seven years ago, the *Journal of Economic Surveys* published the first guidelines for conducting meta-analysis in economics (Stanley *et al.*, 2013). Since that time, economists have embraced meta-analysis as a conventional tool for research synthesis, and more than 2000 new meta-analyses have been conducted, according to the Research Papers in Economics database <https://econpapers.repec.org/>. Research studies published in the most eminent economics journals and structural models employed by central banks now routinely rely on previously published meta-analyses to summarize the existing evidence in the field and to provide information for the calibration of key economic parameters (e.g., Constantinides, 2017; Leeper *et al.*, 2017; Lusardi *et al.*, 2017; Benigno and Fornaro, 2018; Heathcote and Perri, 2018; Auclert, 2019). A growing number of economics meta-analyses have reached the mark of 500 or more citations, examples include Stanley and Jarrell (1989), Gorg and Strobl (2001), Stanley (2001), Woodward and Wui (2001), Zelmer (2003), Weichselbaumer and Winter-Ebmer (2005), Rose and Stanley (2005), and Doucouliagos and Ulubasoglu (2008). In 2019, the *American Economic Review* published its first full paper that focuses on meta-analysis and publication bias (Andrews and Kasy, 2019).

The last 7 years have also witnessed the development of many novel meta-analysis models, with special emphasis on publication and misspecification biases. New techniques include the weighted average of adequately powered estimates by Ioannidis *et al.* (2017) and Stanley and Doucouliagos (2017), unrestricted weighted least squares by Stanley and Doucouliagos (2015, 2017), the selection model by Andrews and Kasy (2019), the p-uniform* model by van Aert and van Assen (2019), the endogenous kink model by Bom and Rachinger (2019), and the stem-based estimator by Furukawa (2020). The use of model averaging techniques, both Bayesian and frequentist, has become common (e.g., Havranek *et al.*, 2015; Havranek and Irsova, 2017; Havranek *et al.*, 2018a; Havranek *et al.*, 2018b). Several important contributions have assessed the incidence and impact of publication bias and p-hacking in economics (Brodeur *et al.*, 2016; Bruns and Ioannidis, 2016; Ioannidis *et al.*, 2017; Brodeur *et al.*, 2018; Christensen and Miguel, 2018), and attention has turned to journal editorial policies (Blanco-Perez and Brodeur, 2020). In response, the *American Economic Review* now discourages the use of eye-catchers (e.g., *, **, and ***) to signal statistical significance.

While the number of published meta-analyses has risen exponentially, the diversity among them has increased as well. Some meta-analyses still rely only on some dozen(s) of observations; yet, it is not uncommon to encounter analyses that employ thousands of estimates and hundreds of thousands of data points. For example, Xue *et al.* (2019) identify 12,778 estimates on social capital and health from 470 studies, and Gechert *et al.* (2019) collect 71 variables to explain heterogeneity among the reported estimates of the elasticity of substitution between capital and labor. Other meta-analyses focus

on experimental economic results instead of the findings from observational econometric studies (e.g., Zelmer, 2003; Imai and Camerer, 2019). While diversity in available data and methods is necessary and enriching, it can also obscure potential abuse of meta-analysis in economics (Nelson and Kennedy, 2009). To avoid misuse in light of recent advances in meta-analysis, members of Meta-Analysis of Economics Research Network (MAER-Net) believes that it is time to update its reporting guidelines and thereby to raise the *minimum* quality standards for this important and rapidly growing field. This update focuses on, in particular, the following issues: robustness checks for publication bias, outlier and leverage identification, economic significance, model averaging, the transformations of reported coefficients, the PRISMA flow diagram (Moher *et al.*, 2009), and the availability of data and code for replication.

Meta-analysis is the systematic review and quantitative synthesis of empirical economic evidence on a given hypothesis, phenomenon, or effect. It seeks both to summarize and explain the wide, often disparate, variation routinely found among reported econometric results (Stanley, 2001). Although other guidelines for conducting and reporting meta-analyses have been offered (Stroup *et al.*, 2000; Higgins and Green, 2017; Appelbaum *et al.*, 2018), none other than Stanley *et al.* (2013) have explicitly considered the type of empirical evidence typically found in applied econometric research. MAER-Net believes that it is appropriate to offer up-to-date guidelines for reporting meta-analyses and to serve as minimal standards for academic journals. The editorial board of the *Journal of Economic Surveys* will expect that all meta-analyses fulfill these updated reporting requirements or give valid reasons why meta-analysts deviate from them.

MAER-Net recommends that *all* meta-analyses and meta-regression analyses in economics should comply with the following reporting protocols.

2. Reporting Guidelines for Meta-Analyses in Economics

Research papers that conduct meta-analysis in economics should include the points detailed below.

2.1 Research Questions and Effect Size

- A clear statement of the specific economic theories, hypotheses, or effects studied.
- A precise definition of how effects are measured (the “effect size”) and their standard errors or other proxies for precision, accompanied by any relevant formulas if transformations are made.
- An explicit description about how measured effects are comparable, including any methods or formulas used to standardize or convert them to a common metric.

2.2 Research Literature Searching, Compilation, and Coding

- A full report of how the research literature was searched. This report should include:
 - the exact databases or other sources used;
 - the precise combination of keywords employed; and
 - the date that the search was completed.
- A full disclosure of the rules for study (or effect size) inclusion/exclusion. This should be accompanied by a PRISMA flow diagram.¹
- A statement addressing who searched, read, and coded the research literature. Two or more reviewers should code the relevant research and disclose a measure of their agreement.
- A complete list of the information coded for each study or estimate. At a minimum, we recommend that reviewers conducting a meta-analysis code:

- the estimated effect size;
- its standard error, when feasible, and the degrees of freedom (or sample size);
- Reviewers conducting a meta-regression analysis also need to code:
 - variables that distinguish which type of econometric model, methods, and techniques were employed;
 - dummy (i.e., 0/1) variables for the omission of theoretically relevant variables in the research study investigated;
 - empirical setting (e.g., region, market, and industry);
 - data types (panel, cross-sectional, time series, . . .);
 - alternative ways that effects were measured and reported before being converted to a common effect size;
 - year of the data used and/or publication year;
 - type of publication (journal, working paper, book chapter, etc.); and
 - the primary study, publication, and/or dataset from which an observation is drawn.
- The rule or method used to identify outliers, leverage, or influence points when omitted.

2.3 Modeling Issues

- A table displaying definitions of all the coded variables along with their descriptive statistics (means and standard deviations).
- A fully reported meta-regression analysis, along with the exact strategy used to simplify it (e.g., Bayesian or frequentist model averaging, general-to-specific, etc.).
- An investigation of publication, selection, and misspecification biases unless these biases can reasonably be expected to be absent. When suspected, these should be controlled for in subsequent meta-regression models.
- Methods to accommodate heteroscedasticity (e.g., inverse-variance weights) and dependence across estimates, such as within-study dependence (e.g., clustered or bootstrapped standard errors and panel or multilevel meta-regression models).

2.4 Further Reporting and Interpretation

- Graph(s) of the effect sizes, such as funnel graphs, forest plots, or other statistical displays of data.
- Robustness checks for meta-regression models and publication bias methods.
- A discussion of the economic (or practical) significance of the main findings.
- “Best practice” estimate(s) and sensible variations from them.²
- A statement about sharing the data or link to its public posting along with the codes of the core analyses.

3. Discussion

Not all meta-analyses in economics will nicely fit into the above list of recommended guidelines. For example, meta-analyses of economic experiments may not be able to conduct meta-regression due to the limited numbers of experiments or to code all of the moderator variables listed above. Again, exceptions to these guidelines may be acceptable when accompanied by a suitable rationale.

A further qualification made by the 2013 MAER-Net reporting guidelines remains relevant:

With one exception, MAER-Net has come to a clear consensus about these reporting guidelines. The requirement to have two reviewers code all the relevant research has received the most comment and discussion. As economists, we all are acutely aware of the tradeoff between the improved quality that the second coder will likely add (through catching mistakes and resolving ambiguities) and the increased cost (in weeks of highly skilled professional labor). We understand that the highest standards of scientific rigor demand at least two highly knowledgeable researchers code the relevant research base. Nonetheless, MAER-Net does not wish to prohibit Ph.D. students and researchers at resource-challenged institutions from employing this important tool to understand their areas of research. To finesse these opposing concerns, the above statement is sufficiently broad to encompass a second reviewer randomly checking a substantial proportion of the research literature if their coding protocol is stated explicitly and justified.

These guidelines are not meant to express the last words about how best to conduct meta-analysis in economics. Rather, we support all efforts to raise the quality of meta-analyses. The above reporting protocols represent a floor for scientific rigor, replicability, and quality that we hope will be surpassed by most meta-analyses—Stanley *et al.* (2013, p. 393).

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Notes

1. The PRISMA flow diagram shows the details of information flow in each stage of literature search in meta-analysis, including the number of studies identified, screened, and deemed eligible (for details, see Moher *et al.*, 2009).
2. Meta-regression estimates map conditional estimates of effect. To provide specific estimates, professional judgment must be used to substitute “best practice” values into the estimated meta-regression for the independent variables (Stanley and Doucouliagos, 2012, pp. 98–99).

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